

**Association Between a Child's Caries Experience and the Mother's Perception of Her  
Child's Oral Health Status**

by

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**Abstract**

**Objectives.** Mothers play a primary role in the health of their children. This role may be of particular importance for children in Appalachia who have increased caries relative to children in other regions of the United States. The authors examined the degree to which a child's caries experience was in concordance with mother's perception of the health of her child's teeth, and how concordance varied by sociodemographic factors.

**Methods.** The authors obtained cross-sectional data on mother-child dyads with children younger than 6 years through the Center for Oral Health Research in Appalachia study. They interviewed and clinically examined a community-based sample of 815 mother-child dyads in Pennsylvania and West Virginia. They used an unadjusted zero-inflated negative binomial model to estimate the association between a mother's perception of her child's oral health status and her child's caries. The authors compared sociodemographic factors between concordant and non-concordant mother-child dyads using  $\chi^2$  tests.

**Results.** The mother's perception of child oral health status was associated with child's caries experience ( $P<.001$ ). Two-thirds of mother-child dyads showed concordance between the mother's perception of her child's oral health status and the child's dental caries experience ( $n=522$ , 64%). Concordance was associated with younger child age and child dental insurance ( $P<.01$ ).

**Conclusions.** On average, mothers accurately perceived their child's caries experience. This accuracy was higher for younger children and children with dental insurance.

**Practical Implications.** The mother's awareness of her child's oral health status has public health significance, as it could be used to develop effective prevention and treatment strategies, particularly for young children vulnerable to dental caries.

## Table of Contents

<b>Acknowledgements.....</b>	<b>ix</b>
<b>1.0 Introduction.....</b>	<b>1</b>
<b>2.0 Methods.....</b>	<b>2</b>
<b>2.1 Study Design and Data Sources.....</b>	<b>2</b>
<b>2.2 Variables.....</b>	<b>4</b>
<b>2.3 Analytical Approach.....</b>	<b>5</b>
<b>3.0 Results.....</b>	<b>7</b>
<b>4.0 Discussion.....</b>	<b>10</b>
<b>5.0 Limitations and Future Research.....</b>	<b>13</b>
<b>6.0 Conclusions.....</b>	<b>14</b>
<b>Bibliography.....</b>	<b>15</b>

## **List of Figures**

<b>Figure 1.</b>	Number of decayed and filled teeth for children under 6 Years in the Center for Oral Health Research in Appalachia study (N=815).....	<b>3</b>
<b>Figure 2.</b>	Association between the Mother's Perception of her Child's Oral Health Status and Dental Caries Experience in the Center for Oral Health Research in Appalachia study (N=815).....	<b>6</b>
<b>Figure 3.</b>	Histograms of the Number of Decayed and Filled Teeth for Children Under 6 Years-Old for each level of Mother's Perception of Child Oral Health Status in the Center for Oral Health Research in Appalachia study (N=815).....	<b>8</b>
<b>Figure 4.</b>	Concordance between a Mother's Perception of her Child's Oral Health Status and Child Dental Caries Experience in the Center for Oral Health Research in Appalachia Study (N=815).....	<b>12</b>

## List of Tables

<b>Table 1.</b>	Descriptive Findings on the Mother’s Self-reported Child Oral Health Status and Child Dental Caries Experience for Children Under 6 Years in the Center for Oral Health Research in Appalachia Study (N=815).....	<b>6</b>
<b>Table 2.</b>	Sociodemographic Variables by Concordance $\infty$ between Mother’s Perception of Child Oral Health Status and Child Dental Caries Experience for Children Under 6 Years-Old in the Center for Oral Health Research in Appalachia Study (N=815).....	<b>9</b>
<b>Table 3.</b>	Zero-inflated Negative Binomial Model of the Association between a Mother’s Perception of Child Oral Health Status and her Child’s Dental Caries Experience for Children Under 6 Years-Old in the Center for Oral Health Research in Appalachia Study (N=815).....	<b>10</b>



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## 1.0 Introduction

Dental caries is one of the most common chronic diseases among children in the United States.<sup>1, 2</sup> Untreated caries can cause pain, disrupted sleep, dysphagia, and increased missed school days resulting in poor school performance.<sup>1, 3, 4</sup> Children in Northern Appalachia have an increased prevalence of decayed, missing and filled teeth relative to children in other regions of the US.<sup>5-7</sup> In 2012, 5% of the 2-year-olds, 21% of the 3-year-olds, 35% of the 4-year-olds, and 51% of the 5-year-olds in Northern Appalachia had dental caries.<sup>7</sup>

The oral health of young children is primarily determined by their mothers; further, 97% of preschoolers live in households where their mother is present.<sup>3, 8-13</sup> A positive maternal attitude is related to a lower incidence of caries in the child, better child oral hygiene, and more dental treatment received by the child.<sup>14</sup> Because a large proportion of a child's early life may be spent with the mother, children may learn routines and habits involving diet and oral hygiene from their mothers.<sup>11, 15</sup> In addition, mothers often are the primary caregivers who seek oral care for their children.<sup>8, 9</sup> Through daily oral health practices and dental health-seeking behavior, a child's oral health status is substantially affected by his or her mother.

Two previous studies examined the association between children's oral health status and mother's perception of her child's oral health needs.<sup>16, 17</sup> Divaris and colleagues<sup>17</sup> found a low correlation, with a Spearman rank correlation coefficient of 0.13, between child oral health status and caregiver's assessment of their children's oral health status within the community-based sample of 53 caregivers of children younger than 3 years in North Carolina. Similarly, Weyant and colleagues<sup>18</sup> used multiple logistic regression and path analysis to analyze 530 parent-adolescent pairs in Pennsylvania and found no association between the adolescent's history of

oral symptoms (pain, difficulty in chewing) and the parent's perception of adolescent's oral health status and treatment need.<sup>17</sup>

Although previous studies depict a low to modest association between children's oral health status and their caregiver's perceptions of their child's oral health status, there is no research analyzing this relationship in a population with persistently high rates of caries such as Northern Appalachia. This study fills that gap by determining the degree to which a mother's perception of her child's oral health status is in concordance with her child's caries experience among mother-child dyads from Northern Appalachia. We hypothesized that concordance between mothers' perceptions and child caries would be low, consistent with previous literature findings of a poor correlation between a caregiver's assessment of child oral health status and the child's restorative dental treatment needs both in children and adolescents.<sup>16, 17</sup>

As a secondary aim, we compared family and child sociodemographic factors between concordant and non-concordant families. Based on previous literature on the impact of income, education, and employment on child's oral health,<sup>18</sup> we hypothesized that families with higher sociodemographic status will have improved concordance between child caries status and the mother's perception of her child's oral health status.

## **2.0 Methods**

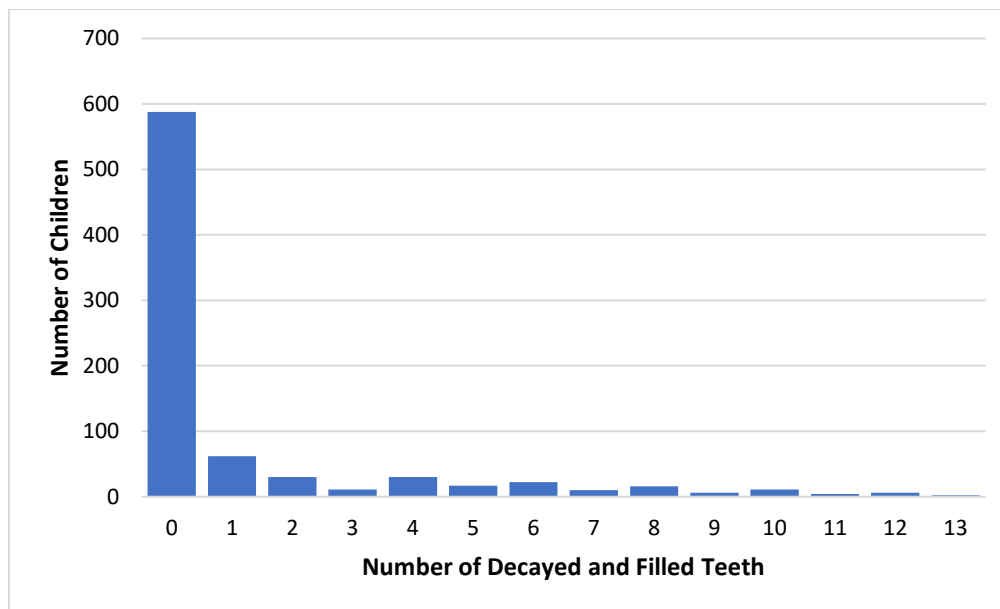
**2.1 Study Design and Data Sources.** We used data collected from the Center for Oral Health in Appalachia (COHRA)<sup>1</sup> study, a cross-sectional investigation conducted from 2002 through 2009 that sought to characterize the oral health of disadvantaged families in rural and

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<sup>1</sup> The Center for Oral Health Research in Appalachia (COHRA) houses numerous studies funded by the National Institutes of Health, one of which is described herein (National Institute of Dental and Craniofacial Research grant R01-DE-014899).

urban locations in Pennsylvania and West Virginia.<sup>7</sup> A non-health care seeking community-based sample was recruited via radio and newspaper announcements, flyers, schools, clinics, and other community public sites.<sup>6</sup>

Caregivers completed structured face-to-face interviews on socio-demographic and oral health factors. After the interview, children underwent clinical exams with trained examiners.<sup>7</sup> The clinical examination of the child included a standardized assessment of the dentition, soft tissues, and supporting structures. Examinations were performed by an assistant and either a dentist or dental hygienist using a dental chair and light.<sup>6</sup> Children younger than 3 years were screened using an abbreviated lip lift examination to assess early childhood caries and missing teeth.<sup>6</sup> After the caries assessment, the decayed, filled tooth (d2ft) index was used to characterize each coronal tooth structure as sound (no caries), decayed (d2 for lesions seen in enamel), or filled (restorations present with no decay).<sup>6</sup>



**Figure 1.** Number of decayed and filled teeth for children under 6 Years in the Center for Oral Health Research in Appalachia study (N=815). *The number of decayed and filled teeth was determined by clinical examination and measured using the decayed and filled tooth (d2ft) index.*

This study was approved by the institutional review board at the University of Pittsburgh and West Virginia University, and informed consent was obtained from all parents and guardians of participants. We limited our analytic sample to female caregivers whose youngest child was younger than 6 years, for a total of 815 non-redundant mother-child dyads.

**2.2 Variables.** The main exposure variable—the mother’s perception of her child’s oral health status—was obtained during the oral health interview in response to the question, “How would you classify the condition of your children’s teeth?” We collapsed the responses to a three-level categorical variable: (1) excellent/very good, (2) good, and (3) fair/poor. We re-assigned “don’t know” (n=25) to missing.

The main outcome variable—child caries experience—was obtained during the child’s clinical exam and measured using the d2ft index. The decayed score was obtained at the d2 level and therefore did not include white spots.

In the absence of a valid and reliable measure of concordance between a caregiver’s perceptions of child oral health and a child’s clinically-determined oral health status, we developed a definition for concordance *a priori*. The mother-child dyad was defined as concordant if they met the following criteria: (1) mother perceived that the child had “excellent/very good” oral health status and the child had a d2ft index of 0, (2) the mother perceives that the child had “good” oral health status and the child had a d2ft index of 1, or (3) the mother perceived that the child has “fair/poor” oral health status and the child had a d2ft index greater than 1.

We also examined concordance by the following sociodemographic variables: family income, child age, child gender, child’s use of fluoridated toothpaste, child’s last dental visit, reason for child’s last dental visit and whether the child had child dental insurance. Family

income was obtained in response to the question, “What is the total yearly income for everyone in the household put together?” and coded as a five-level categorical variable: (1) less than \$10,000, (2) \$10,000 to 14,999, (3) \$15,000 to \$24,999, (4) \$25,000 to \$49,999, and (5) \$50,000 or more. We coded child age as six-level categorical variable corresponding to the age of the child from 1 through 6 years. We coded child gender and child fluoridated toothpaste use as binary variables. We coded child last dental visit as a four-level categorical variable: (1) never, (2) 6 months or less, (3) more than 6 months, and (4) more than 1 year ago. We coded the reason for the child’s last dental visit as a two-level categorical variable: (1) check-up/exam/cleaning and (2) something was bothering the child. Child dental insurance was coded as a three-level categorical variable: (1) none, (2) private, and (3) public.

**2.3 Analytical Approach.** We used descriptive statistics and an unadjusted zero-inflated negative binomial model to examine mother’s perception of her child’s oral health status and child caries experience. The zero-inflated negative binomial model was chosen because of two test results: (1) the goodness-of-fit test ( $P < .05$ ), which rejected the Poisson distribution; and (2) the Vuong test depicted improved fit with the zero-inflated negative binomial model compared with the standard negative binomial model ( $P < .05$ ).

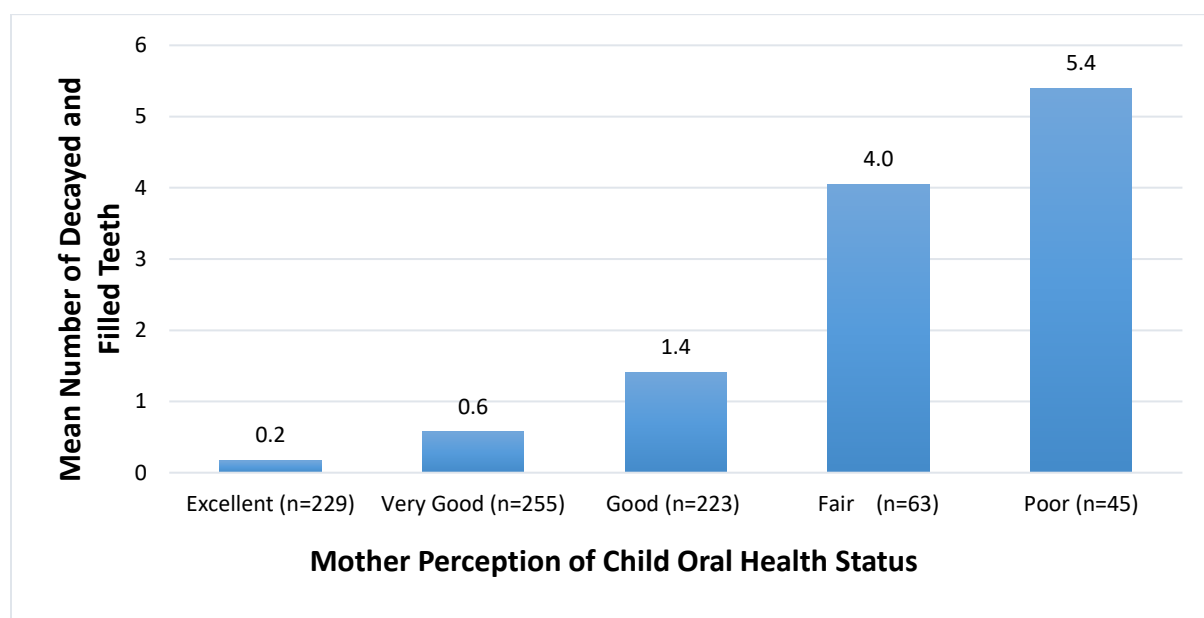
We used descriptive statistics and graphics to explore the distribution of sociodemographic variables (including, family income, child age, child gender, child fluoridated toothpaste use, child last dental visit, reason for child last dental visit, and child dental insurance) between concordant and non-concordant mother-child dyads. We used  $\chi^2$  tests to examine statistically significant associations of sociodemographic variables by concordant and non-concordant mother-child dyads. All analyses were conducted using STATA 15 (StataCorp).

**Table 1.** Descriptive Findings on the Mother’s Self-reported Child Oral Health Status and Child Dental Caries Experience for Children Under 6 Years in the Center for Oral Health Research in Appalachia Study (N=815).

Mother’s Self-Reported Child Oral Health Status	Child Dental Caries Experience (d2ft)*				
	n	Mean	SD <sup>Ω</sup>	Minimum	Maximum
Excellent	229	0.17	0.96	0	11
Very Good	255	0.57	1.60	0	11
Good	223	1.40	2.76	0	12
Fair	63	4.05	3.53	0	12
Poor	45	5.40	3.58	0	13

\*Child Dental Caries Experience was determined by clinical examination and measured using the decayed and filled tooth (d2ft) index.

<sup>Ω</sup> Standard Deviation



**Figure 2.** Association between the Mother’s Perception of her Child’s Oral Health Status and Dental Caries Experience in the Center for Oral Health Research in Appalachia study (N=815).  
*Note: The Child Dental Caries Experience was determined from the child’s clinical examination and measured using the decayed and filled tooth (d2ft) index. A mother’s perception of child’s oral health status was obtained during the oral health interview in response to the question, “How would you classify the condition of your children’s teeth?”*

### 3.0 Results

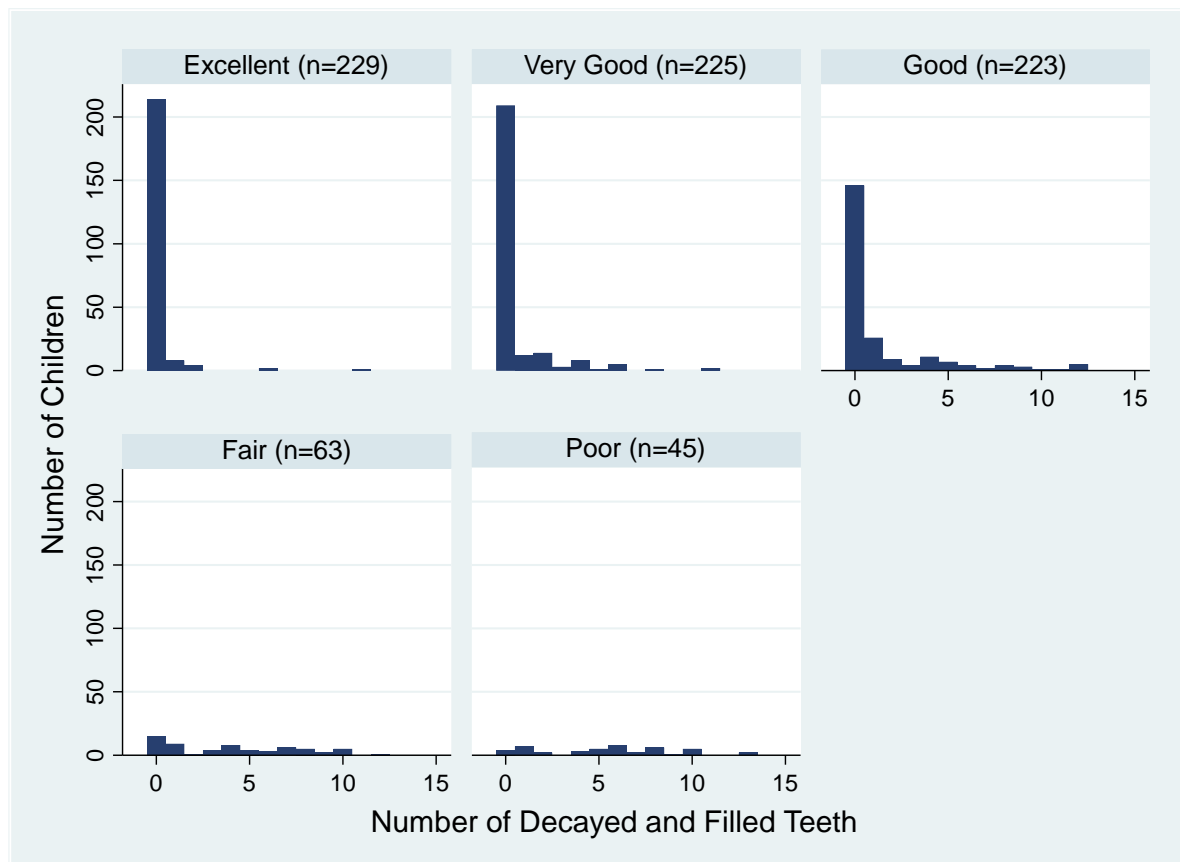
Most of the 815 children (72%) under 6 years included in this study had no caries using the d2ft index (Figure 1). Approximately 8% (n=62) of the children had 1 d2ft and 20% had 2 or more d2ft (Figure 1). Most of the children did not have caries, and most of mothers correctly reported that their child's oral health status was "excellent" or "very good" (n=484, 59%) (Table 1, Figure 2). Moreover, as the mother's perceptions of her child's oral health status worsened, her child's mean d2ft index was greater (Table 1, Table 3, Figure 2). For mothers that reported their children's oral health status as "excellent," the mean d2ft was 0.17 (n=229) (Table 1, Figure 2). For mothers with a child self-reported oral health status of "very good", "good", "fair", and "poor" the mean d2ft index was 0.6 (n=255), 1.4 (n=223), 4.0 (n=63) and 5.4 (n=45) respectively (Table 1, Figure 2). The distributions of the d2ft score shifted higher for each level of mother's report of her child's oral health status (Figure 3). Furthermore, in our unadjusted zero-inflated negative binomial model, we found a significant association between a mother's perception of her child's oral health status and the child's caries experience ( $P<0.001$ ) (Table 2).

The results from our descriptive findings were confirmed in our concordance analysis. We found that approximately two-thirds of the mothers-child dyads showed concordance (n=522, 64%). Therefore, approximately one-third of mothers-child dyads were not concordant (n=293, 36%) (Figure 4).

Concordance between the mother's perception of her child's oral health status and the child's caries experience was associated with child age and child dental insurance status ( $P<0.05$ ) (Table 2). A total of 22% of mother-child dyads in our sample had one-year-old children, of these dyads 17% were concordant and 5% were non-concordant (Table 2). In contrast, 14% of mother-child dyads in our sample had 6-year-old children, of these dyads 9%



were concordant and 5% were non-concordant (Table 2). In general, rates of non-concordance were similar across the child ages from 1 to 6 years-old (5 to 8%) whereas rates of concordance dropped as children grew older (from 17% at child age 1 to 9% at child age 6) (Table 2). Also, a higher percentage of children had dental insurance among concordant mother-child dyads compared to non-concordant mother-child dyads (46% versus 28%) (Table 2). The remaining sociodemographic variables that we examined—family income, child gender, child fluoridated toothpaste use, child last dental visit, and reason for child last dental visit—were not associated with concordance ( $P>0.05$ ) (Table 2).



**Figure 3.** Histograms of the Number of Decayed and Filled Teeth for Children Under 6 Years-Old for each level of Mother's Perception of Child Oral Health Status in the Center for Oral Health Research in Appalachia study (N=815). *Note: Mother's perception of child's oral health status was obtained during the oral health interview in response to the question, "How would you classify the condition of your children's teeth?" The number of decayed and filled teeth was determined by clinical exam and measured using the decayed and filled tooth (d2ft) index.*

**Table 2.** Sociodemographic Variables by Concordance<sup>∞</sup> between Mother's Perception<sup>‡</sup> of Child Oral Health Status and Child Dental Caries Experience\* for Children Under 6 Years-Old in the Center for Oral Health Research in Appalachia Study (N=815).

		Total		Concordant (n=522)		Non- Concordant (n=293)		p-value <sup>α</sup>
		n	% <sup>ε</sup>	n	%	n	%	
<b>Family Income</b>								0.258
	Less than 10,000	177	22	112	14	65	8	
	10,000 to 14,999	115	14	71	9	44	5	
	15,000 to 24,999	122	15	68	8	54	7	
	25,000 to 49,999	200	25	132	16	68	8	
	50,000 or more	68	8	48	6	20	2	
<b>Child Age</b>								<0.001
	1	182	22	141	17	41	5	
	2	147	18	100	12	47	6	
	3	120	15	74	9	46	6	
	4	143	18	74	9	69	8	
	5	108	13	58	7	50	6	
	6	115	14	75	9	40	5	
<b>Child Gender</b>								0.756
	Male	428	53	272	33	156	19	
	Female	387	47	250	31	137	17	
<b>Child Fluoridated Toothpaste Use</b>								0.801
	No	53	7	33	4	20	2	
	Yes	758	93	485	60	273	33	
<b>Child Last Dental Visit</b>								0.074
	Never	394	48	270	33	124	15	
	6 months or less	261	32	160	20	101	12	
	More than 6 months	114	14	70	9	44	5	
	More than 1 year ago	40	5	21	3	19	2	
<b>Reason for Child Last Dental Visit</b>								0.601
	Check-up/exam/cleaning	336	41	205	25	131	16	
	Something bothering them	89	11	57	7	32	4	
<b>Child Dental Insurance</b>								0.002
	None	184	23	128	16	56	7	
	Private	216	27	152	19	64	8	
	Public	391	48	226	28	165	20	

\*Child Dental Caries Experience was determined by clinical exam and measured using the decayed and filled tooth (d2ft) index.

<sup>α</sup>P-values are for chi-square test comparing concordant and non-concordant groups. Values from the missing categories were excluded from the chi-squared test.

<sup>ε</sup>All percentages may not equal 100 due to the exclusion of the missing categories.

<sup>∞</sup>Mother-child dyads were defined as concordant if they met the following criteria: 1) Mother perceived that the child had “excellent/very good” oral health status and the child had a d2ft index of zero, 2) Mother perceived that the child had “good” oral health status and the child had a d2ft index of one, or 3) Mother perceived that the child had “fair/poor” oral health status and the child had a d2ft index more than one.

<sup>‡</sup>Mother’s perception of Child’s Oral health status was obtained during the oral health interview in response to the question, “How would you classify the condition of your children’s teeth?” The responses were coded as a five-level categorical variable: excellent, very good, good, fair and poor.

**Table 3.** Zero-inflated Negative Binomial Model<sup>∞</sup> of the Association between a Mother’s Perception<sup>‡</sup> of Child Oral Health Status and her Child’s Dental Caries Experience<sup>Ω</sup> for Children Under 6 Years-Old in the Center for Oral Health Research in Appalachia Study (N=815).

	Model coefficient (Standard Error)	95% Confidence Interval	P-value
<b>Mother’s Perception of Child’s Oral Health Status</b>			<0.001
Excellent	Referent		
Very Good	0.29 (0.33)	-0.33, 0.93	0.372
Good	0.62 (0.31)	0.01, 1.22	0.046
Fair	0.94 (0.32)	0.32, 1.56	<0.001
Poor	1.07 (0.32)	0.44, 1.70	<0.001
<b>Constant</b>	0.62 (0.29)	0.04, 1.20	0.035

<sup>∞</sup>Zero-inflated Negative Binomial Model was chosen due to the goodness-of-fit test ( $P < 0.05$ ), which rejects the Poisson distribution, and the Vuong test ( $P > 0.000$ ), which showed that a zero-inflated model was a better fit than a non-zero-inflated-negative binomial model.

<sup>‡</sup>Mother’s perception of child’s oral health status was obtained during the oral health interview in response to the question, “How would you classify the condition of your children’s teeth?”

<sup>Ω</sup>Child Dental Caries Experience was determined by clinical exam and measured using the decayed and filled tooth (d2ft) index.

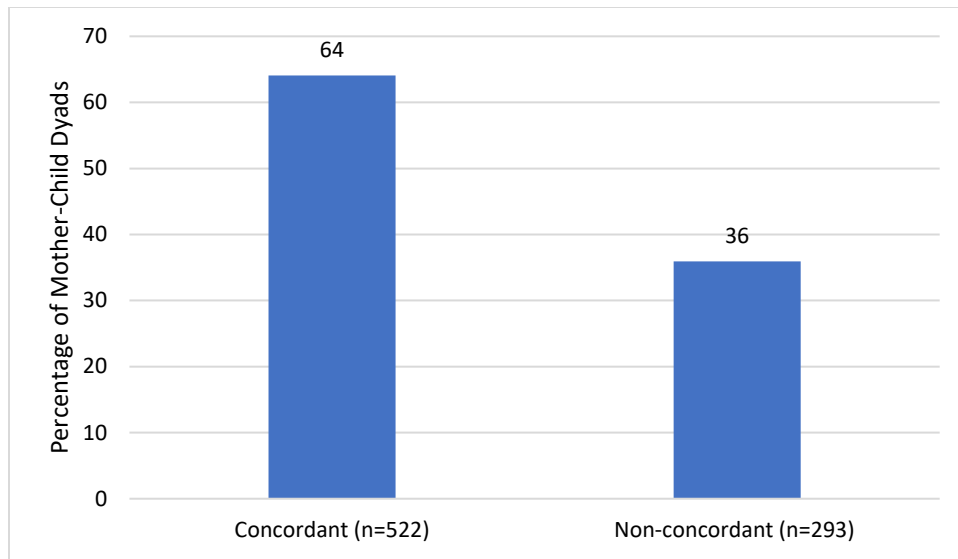
## 4.0 Discussion

In this study, a mother’s perception of her child’s oral health status was significantly associated with her child’s clinical presentation of caries. Most young children did not have previous caries experience; and in general, mothers accurately assessed that their children had excellent or very good oral health status. For children younger than 6 years, mothers in this

Northern Appalachian sample were, on average, accurate in their assessment of their child's oral health. Our result was contrary to our hypothesis, that a mother's perception of her child's oral health status may have poor concordance with the child's dental caries experience based on the studies by Divaris and colleagues<sup>17</sup> and Weyant and colleagues.<sup>16, 17</sup>

When comparing our results to the community-dwelling sample of caregiver-child dyads in the study by Divaris and colleagues<sup>17</sup>, our study design differed with respect to the outcome measure and limiting caregivers to only mothers.<sup>16</sup> Divaris and colleagues<sup>17</sup> compared caregiver's perceptions to child's clinically determined treatment needs while we compared mother's perceptions to child's previous dental caries experience using the d2ft index. The d2ft index was obtained by clinical examination with trained research staff and may be more accurate at capturing the child's oral health status. In addition, mothers, as opposed to other caregivers, may be more attuned to their children's oral health, which may have contributed to the stronger concordance in our study.

The concordance results for this study were also different than the findings in the study performed by Weyant and colleagues.<sup>17</sup> The main difference between these studies is that the children in this study were all younger than 6 years and consequently, not able to express their oral health care needs like the adolescents examined in the study performed by Weyant and colleagues.<sup>18</sup> Compared with adolescents, young children are more dependent on their mothers for oral health practices; and mothers may spend more time with their children at a young age. Therefore, mothers may have more information necessary to assess their child's oral health status because of the closer relationship of young children with their mothers compared to the distance that many adolescents naturally create with their parents.



**Figure 4.** Concordance between a Mother’s Perception of her Child’s Oral Health Status and Child Dental Caries Experience in the Center for Oral Health Research in Appalachia Study (N=815). *Note: Child dental caries experience teeth was determined by clinical exam and measured using the decayed and filled tooth (d2ft) index. The mother-child dyad was defined as concordant if they met the following criteria: 1) Mother perceived that her child had “excellent/very good” oral health status and the child had a d2ft index of zero, 2) Mother perceived that her child had “good” oral health status and the child had a d2ft index of one, or 3) Mother perceived that her child had “fair/poor” oral health status and the child had a d2ft index more than one.*

A second main result of this study was that the rate of concordance varied by child age and dental insurance status. Child age was significantly associated with concordant mother-child dyads, particularly for children younger than 2 years. This finding—that mothers of young children are attuned to their children’s oral health status—may also indicate that early childhood is a window of opportunity during which mothers may be receptive to oral health messages and interested in starting a pattern of preventative oral health behaviors. Public health advocates can capitalize on this time during which mothers may be motivated to take their child to the dentist. Therefore, the accuracy of assessing the oral health of young children by mothers in Northern Appalachia has the potential to drive adherence to the age 1 dental visit endorsed by the American Academy of Pediatrics, American Dental Association, Academy of General Dentistry,

and American Academy of Pediatric Dentistry.<sup>19-22</sup> Concordance when the child is at a young age may also provide a window during which mothers may be receptive to children's oral health information provided during an age 1 dental visit.

Child dental insurance was also significantly associated with concordant mother-child dyads. This factor is widely accepted as influencing a child's ability to obtain oral health care, thus effecting a child's oral health status. According to the US Surgeon General's Report *Oral Health in America*, "uninsured children are 2.5 times less likely than insured children to receive dental care."<sup>1</sup> Therefore, the same elements that drive a mother to obtain and utilize dental insurance for her child may cause her to be more aware of her child's oral health status, supporting the results of this study.

## **5.0 Limitations and Future Research**

Our study has several limitations and opportunities for future research. First, our analysis was limited to an association based on the cross-sectional study design. Second, mothers may have a reporting bias in favor of better health, which would result in an over-estimation of concordance in this study because most of the children had no previous caries experience. Third, future research can examine caries trends and concordance stratified by age cohort, particularly because of the strong relationship between caries and age combined with the potential reporting bias toward overestimating health. Fourth, fathers and other caregivers are important in determining a child's oral health, so future research should include them. Fifth, the results of our study may have limited generalizability to other populations in the United States. Sixth, our results are dependent on the definition of concordance developed for this study. Future research is needed to examine the relationship between this definition of concordance and oral health

outcomes in children. Finally, the findings from our study, combined with both a conceptual framework and the results in previous literature, can be used in future research to develop multivariate model on the predictors of mother-child concordance. If we are able to identify the factors that predict concordance and develop interventions that give mothers the best situation possible to maximize awareness of her child's oral health, then both preventative oral health behaviors and timely dental treatment may be improved, particularly for young children vulnerable to caries.

## **6.0 Conclusion**

Ours was the first study to examine concordance between a mother's perception of her child's oral health status and the child's caries experience in a population with persistently high child dental caries: those living in Northern Appalachia. The positive association of a mother's perceptions of her child's oral health status and her child's caries experience suggests that mothers in the COHRA study accurately perceived their child's caries. This finding is testament to the importance of self-reported oral health outcomes in disadvantaged populations.

Moreover, a mother's awareness of her child's oral health status could be used to aid in effective prevention strategies for early childhood caries. From a clinical and dental public health perspective, our finding of accuracy among mothers' assessments of their children's oral health can lead to optimal children's oral health behaviors and improved dental health-seeking patterns for children. Dental public health stakeholders can also harness mothers' ability to accurately assess their children's oral health when developing resources to help reduce child caries in Northern Appalachia.

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